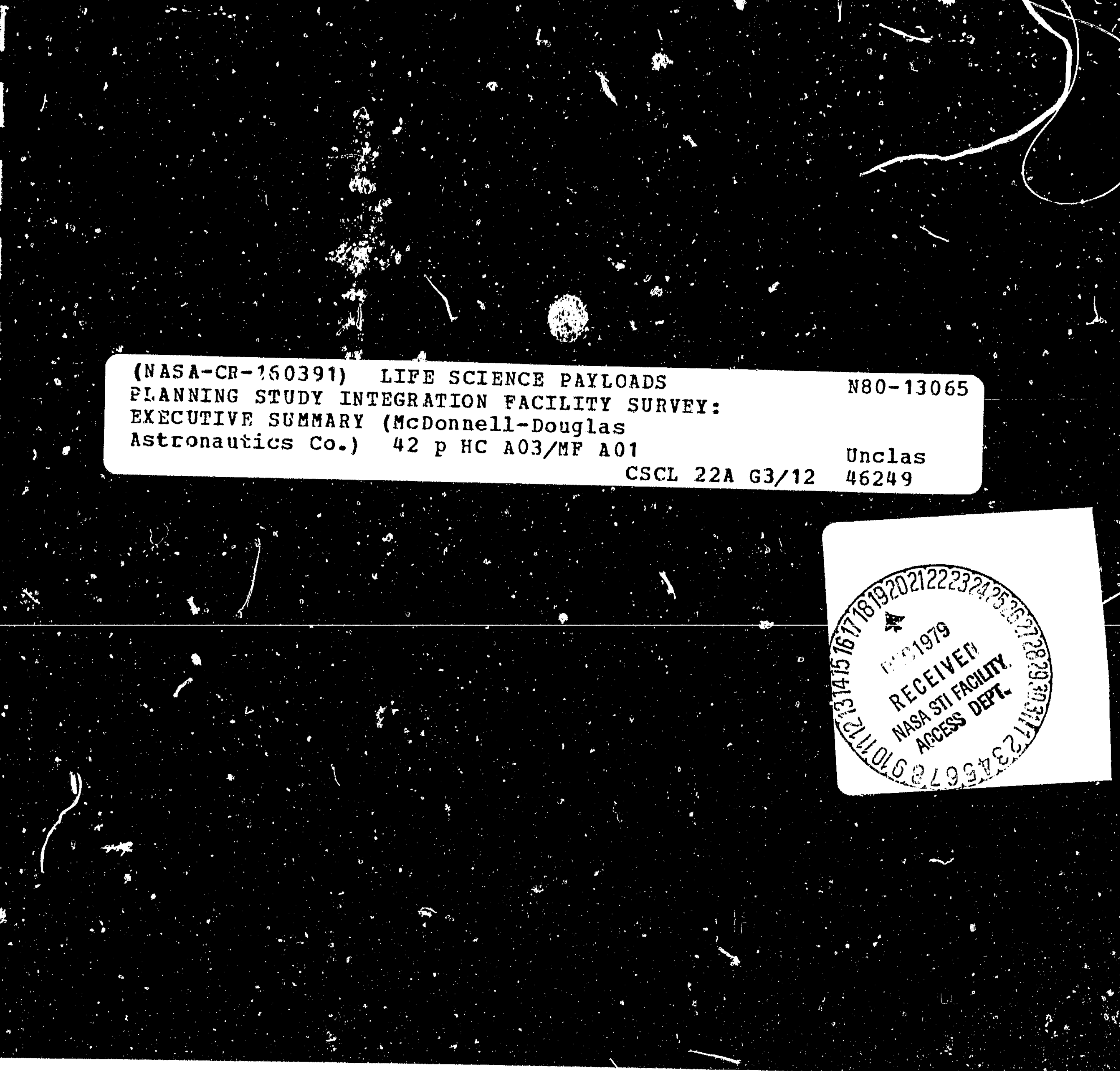

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LIFE SCIENCE PAYLOADS PLANNING STUDY INTEGRATION FACILITY SURVEY

Executive Summary

NOVEMBER 1976

MDC G6579

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PREFACE

This document was prepared by the McDonnell Douglas Astronautics Company for the NASA Johnson Space Center, Life Sciences Directorate, under Contract NAS 9-14589 and presents the Integration Facility Survey Results (Task 2) of the Life Science Payloads (LSP) Planning Study.

The documentation produced under Task 2 of the contract consists of this document and McDonnell Douglas Astronautics Company report MDC G6275, Integration Facility Survey Results, November 1976.

The LSP Planning Study develops planning data that covers overall acquisition, staging, and integration of payload elements, and provides information on program implementation, mission support and data disposition for Life Science Payloads.

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ABBREVIATIONS

TERM	EXPLANATION
AFD	Aft Flight Deck
ARC	Ames Research Center, Moffett Field, California
BESS	Biomedical Experiments Scientific Satellite
CDMS	Command and Data Management System
CORE	Common Operational Research Equipment
EMI	Electromagnetic Interference
FCT	Flight Control Team
GSFC	Goddard Space Flight Center, Greenbelt, Maryland
IF	Interface
JPL	Jet Propulsion Laboratory, Pasadena, California
JSC	Lyndon B. Johnson Space Center, Houston, Texas
KSC	John F. Kennedy Space Center, Florida
L/S	Launch Site or Landing Site
LS	Life Science
LSMA	Life Sciences Monitoring Area
LSP	Life Science Payloads
LSPF	Life Science Payloads Facility
MCC	Mission Control Center
MSS	Mission Specialist Station
NASA	National Aeronautics and Space Administration
PE	Payload Engineer or Project Engineer
PI	Principal Investigator
POC	Payload Operations Center
POCC	Payload Operations Control Center
PSS	Payload Specialist Station
RAU	Remote Acquisition Unit
ROM	Rough Order-of-Magnitude
SMD	Spacelab Mission Development
SMS	Spacelab Mission Simulation
STS	Space Transportation System
VAFB	Vandenberg Air Force Base, Lompoc, California
WTR	Western Test Range

Section 1
INTRODUCTION

Purpose

Analyses of proposed Life Science Shuttle era payload operations have indicated, and ground based tests verified, that plans to perform integration, checkout, mission development testing, and in-flight monitoring of Life Science Payloads at NASA-JSC are feasible, and that the scientific return will be cost effectively increased with this method of operation (see References 1 through 5).

This document presents a summary of results from a survey conducted to: (A) examine facility and equipment resources needed for Life Science Payload integration, checkout, test and mission support activities; (B) identify presently available resources; and (C) determine methods by which operational era status may be implemented based on currently available resources.

The term "Integration Facility" as used in this report refers to the primary facility and equipment resources necessary to conduct Life Science Payload (LSP) operations at NASA-JSC.

Supporting data and additional information concerning the requirements and concepts described in this summary document may be found in the Life Science Payloads Planning Study Integration Survey Results, MDC G6275, dated November 1976, and in the Integration Facility Survey Data Sheets, MDC G6578, dated November 1976.

Scope

The Life Science Payload Integration Facility Survey was conducted to determine accommodations needed and those presently available for the development, test, integration, checkout, and flight support of Life Science Carry-on Labs, Minilabs (shared Spacelab payloads), and Dedicated Labs (Spacelab payloads

in which all experiments aboard are in the discipline of Life Science). Primary emphasis was placed on those integration and flight support activities to be conducted in NASA-JSC Building 36. However, additional JSC facilities identified as capable of providing direct support to Life Science Payload activities were also examined and documented.

Guidelines and Assumptions

The major guidelines and assumptions used for the Integration Facility survey are listed below. A discussion of the rationale used in the formulation of assumptions and of the sources for the guidelines is included in Reference 6.

- The 30 November 1975 Dunning Life Science Traffic Model reflects the processing load to be accommodated (see Figure 1-1 and Reference 7). Impacts of other traffic rates were not investigated.
- Individual experiments as well as full racks must be combined into flight-ready packages at the facility. A composite of Integration Facility activities is shown in Figure 1-2.
- Interfaces connected in the Integration Facility will remain connected, wherever practical, through flight.
- Most experiments processed will not require extensive fabrication capability at the Integration Facility.
- In-building transporters will be used as both a means of moving elements within the facility and as integration stands.
- Mock-ups of the Spacelab pressurized module, and the Orbiter mid-deck and aft flight deck will be required for payload tests. Subsystem functions in the mock-ups may be performed by lower cost non-flight hardware.
- Components undergoing final integration, test, and checkout must be maintained in a class 100,000 cleanliness level environment (see References 8 and 9).

CALENDAR YEAR	1980	1981	1982	1983	1984 *
MINILAB	Δ Δ	Δ Δ	Δ Δ	Δ Δ	Δ Δ
CARRY-ON LABS	Δ Δ	Δ Δ	Δ Δ	Δ Δ	Δ Δ
DEDICATED LABS					
7 DAY	Δ	Δ	Δ		
30 DAY			Δ	Δ Δ	Δ Δ

* 1985 through 1991 same as 1984.

FIGURE 1-1: LIFE SCIENCE PAYLOADS TRAFFIC MODEL (REFERENCE 7. BESS FLIGHTS NOT SHOWN)

Approach

Based on the above major guidelines and assumptions, the Integration Facility survey was carried out in a nine-step process. These nine tasks are shown in the flow diagram of Figure 1-3.

FIGURE 1-2

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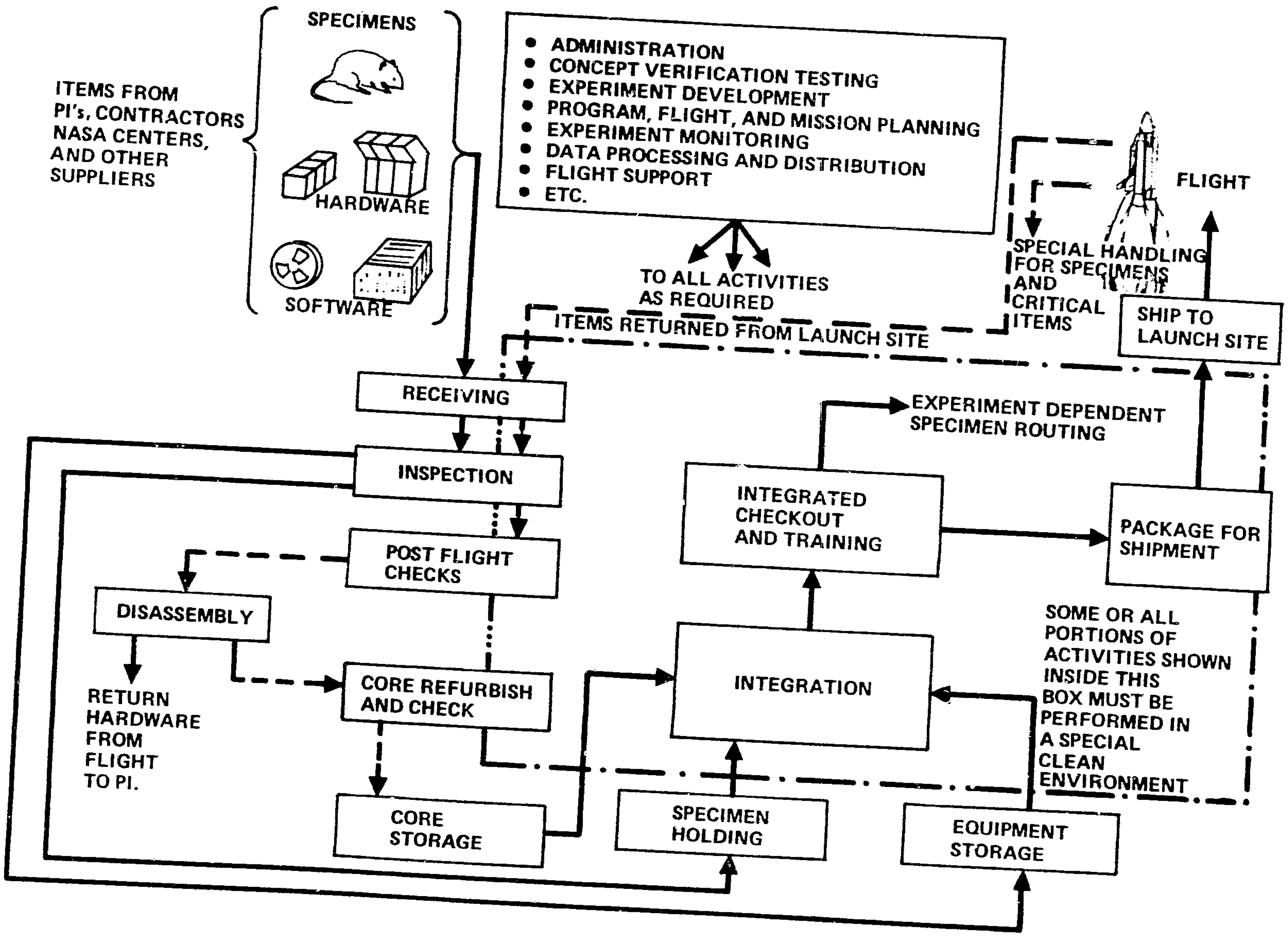
TOP LEVEL JSC LIFE SCIENCE PAYLOADS INTEGRATION FACILITY ACTIVITIES



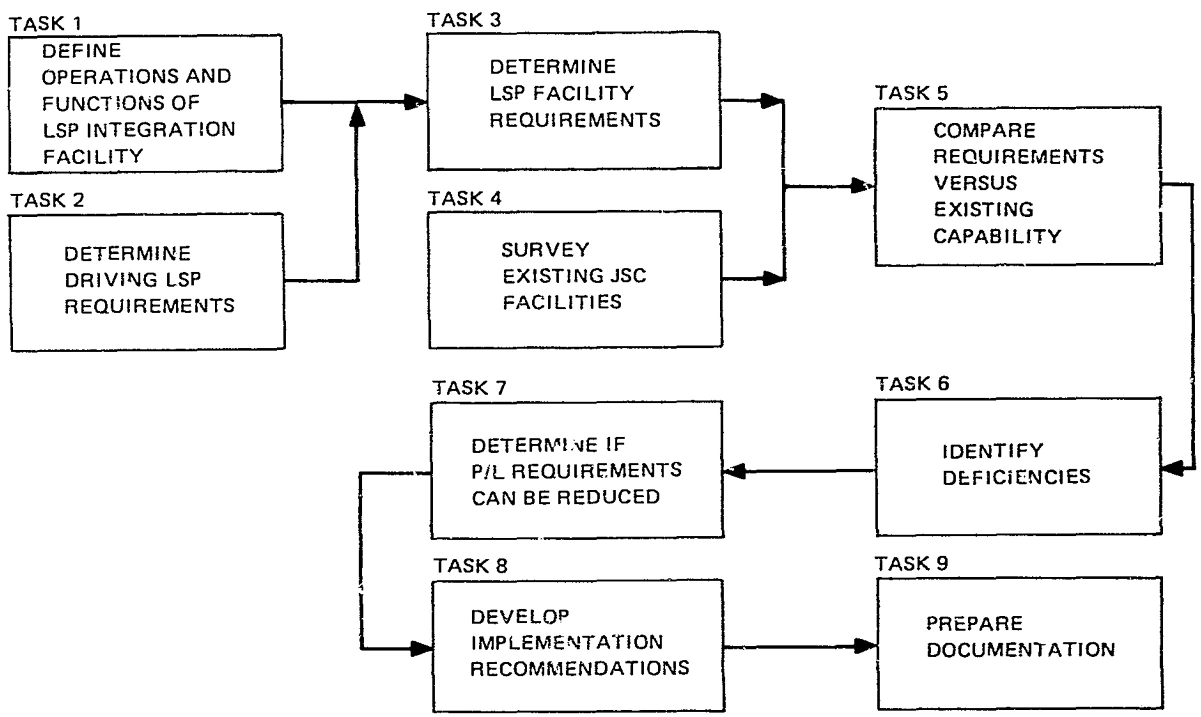


Figure 1-3. integration Facility Survey Task Flow Diagram

Section 2

INTEGRATION FACILITY PROCESSING REQUIREMENTS

Processing Area Characteristics and Requirements

Initial efforts of the LSP Integration Facility survey were conducted to determine the top level operations which must be conducted in the JSC Life Science Payload processing area. As a result, twelve major sub-facilities composed of 30 lower level processing areas were identified. An assessment of the major facility characteristics and requirements of each of the 30 processing areas was made, based on the assumptions and guidelines used and on processing rate information developed in Reference 2.

Summation of the individual processing area requirements indicated that primary integration and checkout activities would require 1,385 m^2 (14,900 ft^2) of which about 700 m^2 (7,500 ft^2) should be environmentally controlled to the class 100K cleanliness level. An overall area of slightly over 2,040 m^2 (22,000 ft^2) was projected for support laboratory activities of the integration facility, and 420 m^2 (4,500 ft^2) were estimated as required for outside dock and storage activities. A total of 5,072 m^2 (54,600 ft^2) was estimated to be required for all Integration Facility activities.

Equipment Requirements

In addition to facility space requirements, the support equipment requirements were also evaluated in the same survey phase. GSE items presently on NASA/ESA GSE listings (References 10 and 11) were reviewed for applicability to the Integration Facility operations, and 25 items whose capabilities corresponded with those necessary for LSP activities were identified. An additional list of 39 items was also prepared which specified items providing flight hardware support that NASA/ESA GSE items were not cost effectively capable of providing. Other support equipment required for use in the Integration Facility was also defined on an area by area basis. Preliminary rough order-of-magnitude (ROM) costs were estimated for these support equipment items and for the GSE items.

Section 3

SURVEY OF EXISTING JSC FACILITIES

Building 8, 36, and 37

A review was conducted to document the capabilities of existing JSC facilities and equipment having possible applicability to LSP processing. This effort defined the presently available nucleus about which LSP operations may be most economically implemented. The review documented the arrangement, floor space, door sizes, utility services, and existing support equipment available. Results were condensed and are presented in tabular form in Reference 6. Detailed data sheets may be found in Reference 12.

Building 36, considered the most favorable location for the majority of LSP processing operations, received the survey emphasis; however, two other buildings at JSC, identified as having applicable unique capabilities, were also examined. These additional sites included:

a) Building 8, found to have medical examination capabilities which will be useful in collecting baseline data from crewmembers and other test subjects.

b) Building 37, presently being reconfigured to provide a common site for most Life Sciences scientific laboratories. This capability will be required to support tests and analyses required by experiments during integration/test activities as well as during pre- and post-flight activities.

A summary of the usable space in the facilities surveyed is indicated in Table 3-1.

Table 3-1

FACILITY AREA SUMMARY

LOCATION	AREA m^2 (ft^2)
BUILDING 36	
NORTH WING - OFFICE AREA	540 (5,800)
SOUTH WING - FIRST FLOOR USABLE AREA	1,860 (20,000)
- SECOND FLOOR USABLE AREA	810 (8,700)
- THIRD FLOOR OFFICE AREA	490 (5,300)
	3,700 (39,800)
BUILDING 8	
FIRST FLOOR MEDICAL DISPENSARY AREA	670 (7,200)
BUIDLING 37	
FIRST FLOOR - LABORATORIES AREA	2,000 (21,500)
- OFFICE AREA	1,630 (17,500)
SECOND FLOOR - ARCHIVAL AREA	300 (3,200)
THIRD FLOOR - LABORATORY AREA	130 (1,400)
	4,060 (43,600)

Section 4

IMPLEMENTATION OF REQUIREMENTS

Development of Facility Concepts

A comparison of the facility review results with the subfacility requirements verified that the most logical location for equipment receiving and shipping, integration, test, checkout, test monitoring and in-flight science support for Life Science Payloads was the Building 36 south wing area. Previous SMS II activities conducted in a portion of this area have also demonstrated that operations similar to those projected for Life Science flight payloads are well suited to this location.

Two plans were developed by which LSP Integration Facility activities may be cost effectively implemented at JSC. The first of the two designs is for an Integration Facility in which the Bioengineering and Test Support Facility (Building 36) is shared between Life Sciences and other disciplines. In this concept the Building 36 space assigned to LSP operations will approximate that presently assigned to Life Sciences. Floor space for PI and contractor office areas, equipment storage, and additional required functions must be made available in other JSC facilities.

The second design illustrates a configuration in which as many LSP functions as possible are co-located in Building 36. This concept will result in reduced transit time between activity sites for personnel, reduced equipment movement, and improved communications. However, it does require that Building 36 be dedicated only to operations associated with Life Science Payloads.

Summary descriptions of layouts for both the shared and dedicated LSP Integration Facility concepts are provided in the following text.

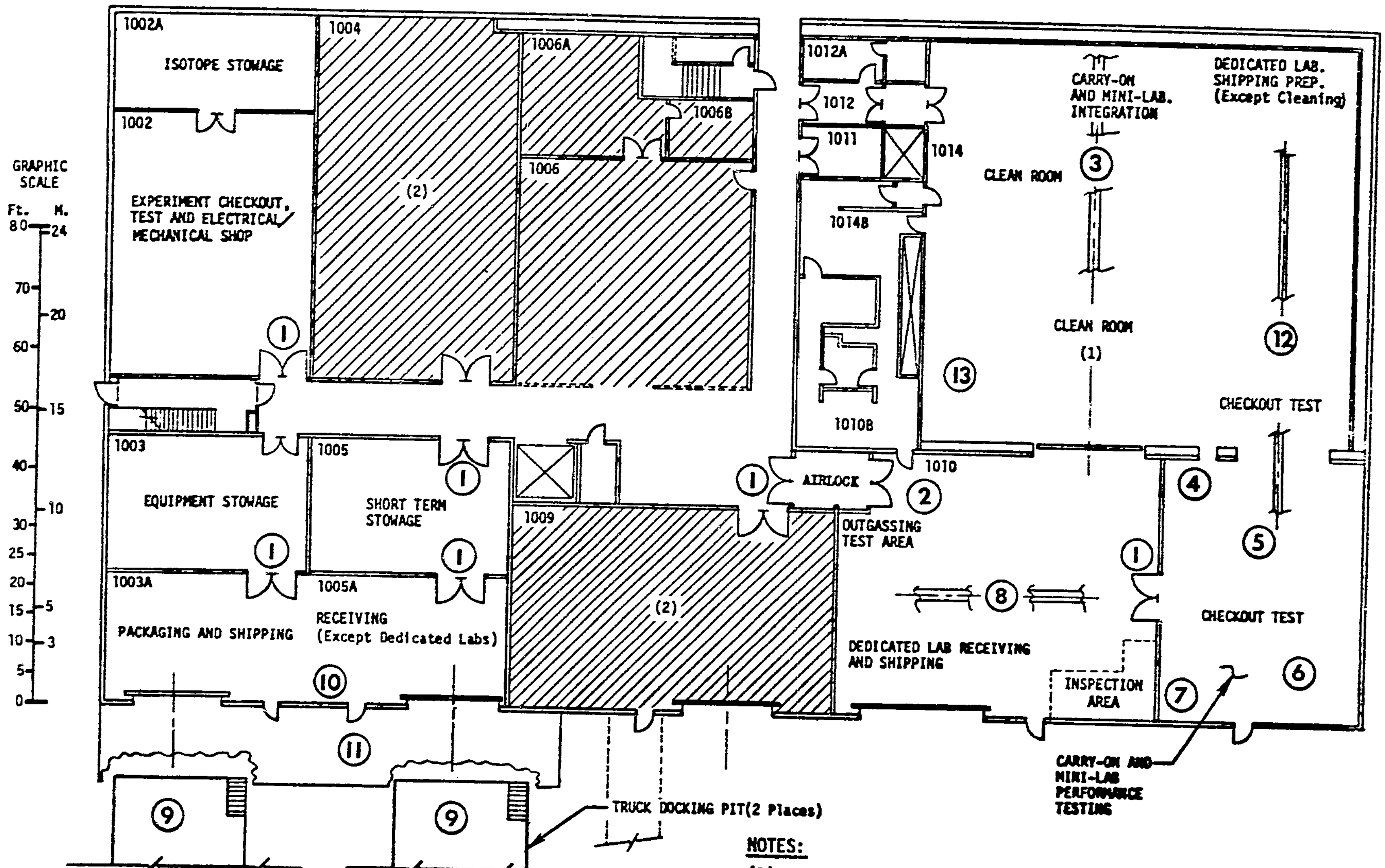
LSP Shared Facility Description

The shared facility concept defines a functional LSP supporting arrangement in which areas and equipment in Building 36 are used jointly with other JSC Directorates. The arrangement limits Life Sciences to portions of levels one and two of the facility, and with this concept several LSP functions must be located in other JSC buildings. Specific buildings needed and the availability of the necessary areas within these buildings have not yet been determined. The shared facility concept allocates approximately 1,580 m^2 (17,000 ft^2) within Building 36 for Life Science functions, housing only the mandatory payload integration/checkout operations and directly supporting equipment. It was assumed in the development of this concept that no portion of the third floor of Building 36 would be utilized by Life Sciences. Subfacilities were combined wherever possible in the formulation of layouts for this concept; the resulting payload processing facility will require precise coordination and scheduling of activities to support the full operational era traffic model.

Building 36 layouts for the shared facility mode are depicted in Figures 4-1 and 4-2. Circled numbers on the figures refer to required modifications to the facility as described in Table 4-1.

With the arrangements shown in Figures 4-1 and 4-2, individual racks, experiments, and equipment will be removed from over-the-road transport vehicles and placed on in-building GSE transport dollies for movement to receiving, inspection, storage and processing areas. Shipping and receiving areas are located in rooms with existing cargo doors to facilitate equipment movement; however, several smaller doors within the facility must be enlarged to allow passage of Spacelab racks in the upright position.

Complete rack/floor sets and other large items arriving at the facility by truck will be handled in a different manner. The doors from Room 1010 to the clean room will be operationally held closed, and the exterior cargo



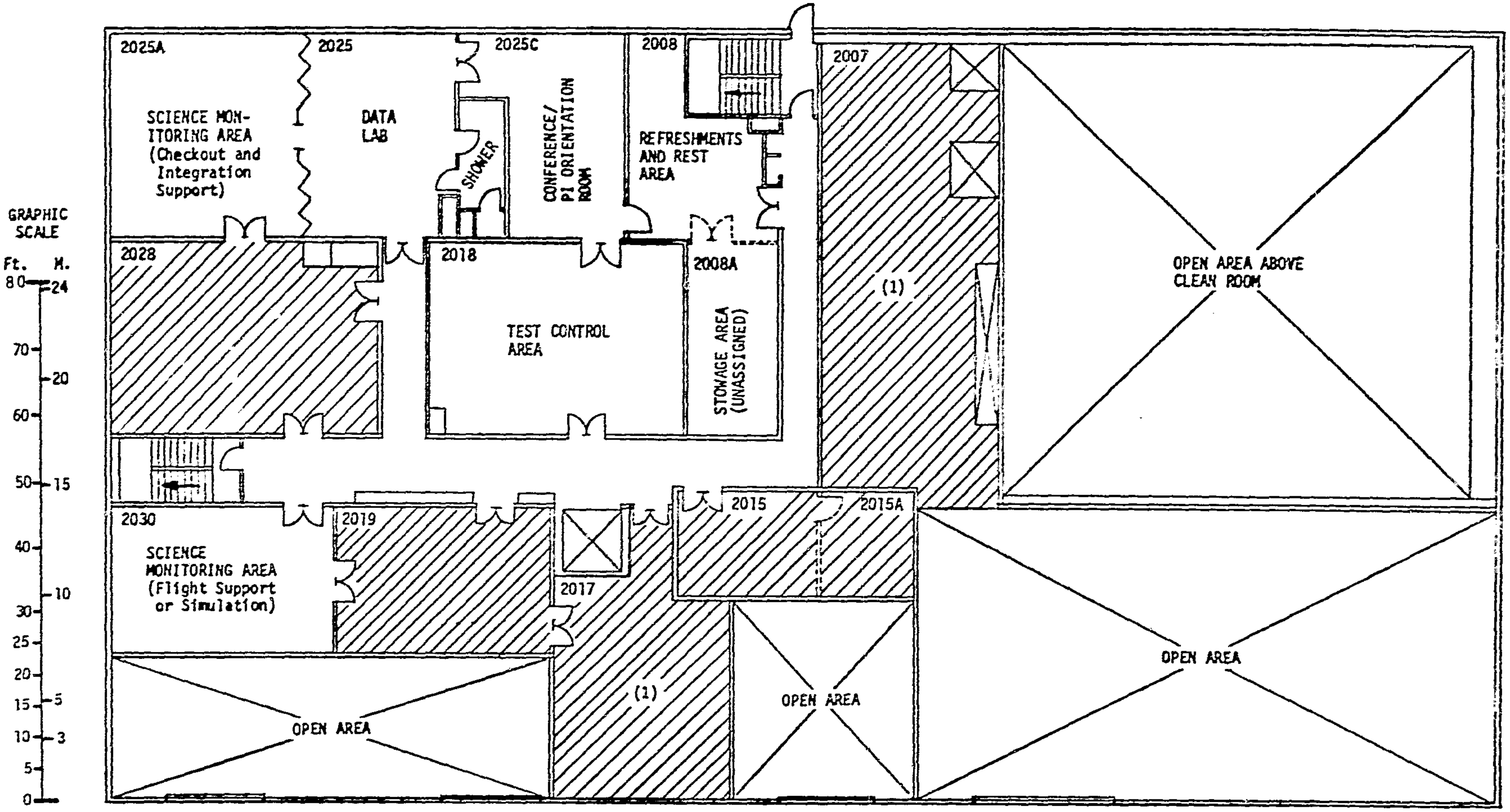
NOTES:

(1) 2/3 of clean room space required by Life Sciences

(2) Cross-hatched area assigned to non-LSP operations

(3) Total area available for LSP operations on this sheet equals 1096 M^2 (11,780 ft^2)

FIGURE 4-1: Life Sciences Facility Layout, Shared Facility Operations, Building 36, South Wing, First Level



NOTES:

(1) Cross-hatched areas assigned to non-LSP operations

(2) Total area available for LSP operations on this sheet equals 486 M^2 (5,230 ft^2)

FIGURE 4-2: Life Sciences Facility Layout, Shared Facility Operations, Building 36, South Wing, Second Level

Table 4-1
DESCRIPTION OF FACILITY MODIFICATIONS

IDENTIFICATION CODING	DESCRIPTION
1	Remove existing doors and install 3.0 m (118 in.) high by 2.4 m (96 in.) wide (double) doors to allow inbuilding transport of racks on GSE carts.
2	Relocate existing entranceway to corridor walk, fabricate 3.66m (12.0 ft) by 2.99m (9.8 ft.) airlock and install second 3.0 x 2.4 m (118 x 96 in.) door to maintain cleanliness during personnel and small equipment item ingress/egress.
3	Install 9 x 10^3 Kg (10 ton) traveling crane full length (north-south) of clean room. It is anticipated that the existing crane mechanism controls and trackage in room 1010 could be utilized. Facility prints indicate that the building structure will be able to support the crane loads. [7.6m (25 ft) hook height required.]
4	Extend sliding door track structure/mechanism on west side of large door opening; remove smaller (east) sliding door. Door may be stowed for possible future reinstallation.
5	Install ceiling and interior wall surfaces to maintain 100K clean room level.
6	Remove existing room 1010A walls and ceiling.
7	Install wall at designated location and finish both sides to maintain 100K class clean level. Install ductwork and blowers to connect room 1010 and mock-up areas to clean room air filtration system.
8	Replace existing 9 x 10^3Kg (10 ton) traveling crane with 18 x 10^3 Kg (20 ton) unit. Hook height of 9.2m (30 ft.) required.
9	Install two truck docking pits including safety rails for cargo handling.
10	Remove existing wall between rooms 1003A and 1005A (between 1009 and 1005A for dedicated facility configuration).
11	Install 38.1m (125 ft.) long by 4.0m (13 ft.) canopy over loading area.
12	Install 1.8 x 10^3 Kg (2 ton) traveling crane full length of Spacelab mock-up area [approx. 35m (115 ft.)]. Hook height of 6.7m (22 ft.) required.
13	Refurbish/reactivate Building 36 clean room

NOTE: The above list includes only the top level modifications required in each subfacility. Alternate routing of electrical utilities, minor structural modifications, air-conditioning ductwork relocation, suspended ceiling changes, etc., will be required at various locations dependent on the final facility design. All modifications will require detailed designs prior to execution.

door opened. The shipment will be backed into Room 1010 and lifted off the transporter by a 18×10^3 Kg (20 ton) overhead crane. The transport vehicle will then be driven out of the building and the cargo door closed. The shipment will remain inside the sealed shipping container until the environment in Room 1010 can be returned to a class 100K cleanliness level by means of duct-work added to connect this area with the clean room environmental conditioning equipment. The shipping canister may then be opened and the cargo positioned on an in-building GSE transport dolly. The dolly with its cargo may be moved into the clean room through the existing interior cargo door.

A layout of the clean room area in which most integration and checkout test activities will be accomplished is indicated in Figure 4-3. Life Science processing will require approximately 2/3 of the clean room area during shared operations. Figure 4-3 also shows an added non-load bearing partition across Room 1010. This wall, in conjunction with ducts added to the clean room air handling system, allows the clean room area to be increased without major building structural changes.

Floor space requirements for LSP operations developed as outlined in Section 2 are shown alongside the accommodations provided by the shared facility concept in Table 4-2.

The LSP supporting subfacilities which would be located in other areas if the shared facility concept is implemented include: (1) facility maintenance, (2) flammability testing, and (3) portions of experiment development, shipping, receiving, storage and PI offices. Floor space requirements for these remotely located areas have been defined, but the preparation of area layouts has been deferred until available space within specific buildings is designated.

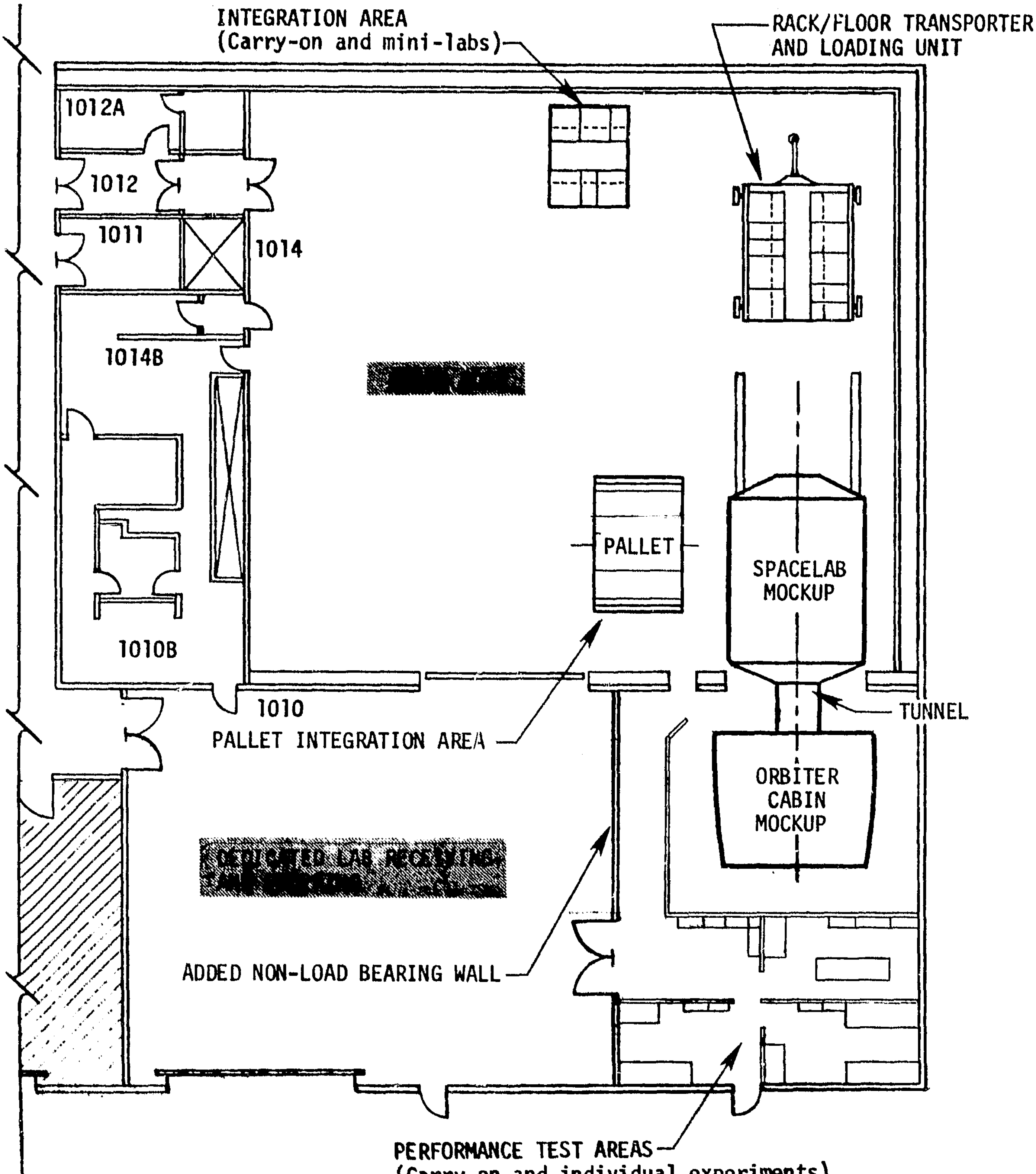


FIGURE 4-3: Conceptual Layout of Life Sciences Payload Checkout Test Area, Shared Facility Operations

Table 4-2

COMPARISON OF ACCOMMODATIONS VS. REQUIREMENTS - SHARED LSP INTEGRATION FACILITY

Subfacility	PROPOSED DESIGNS			REQUIREMENTS		Remarks
	Location Building/Room	Space m^2	Space (ft^2)	Space m^2	Space (ft^2)	
Shipping and Receiving	36/1003A, 36/1005A, part of 36/1010 and 36/1014, dock area	361*	(3,880)	300	(3,250)	119 m^2 (1280 ft^2) of 36/1010 used. 36/1014 space used on "as required" basis, * includes outside dock
Special Requirements/Items Holding Area	TBD (experiment dependent)	90 (TBD areas assumed)	(950)	90	(950)	
Equipment Storage	36/1003 plus other TBD areas	36/1003 74 TBD areas 591	(797) (6,353)	665	(7,150)	
Experiment Test/Checkout Lab	Part of 36/1002 and 36/1014	99	(1,065)	80	(850)	Assume one-half of 36/1002 and 28 m^2 (310 ft^2) of new walled area in 36/1010 is used for checkout
Experiment Development Lab	Part of 36/1002 - plus other TBD areas in Bldg. 37	36/1002 70 TBD areas 97	(755) (1,045)	165	(1,800)	Assume one-half of 36/1002 is used for development
Clean Room Integration Area	Part of 36/1014	179	(1,928)	230	(2,500)	Area is 2/3 of 36/1014 area less 95 m^2 (1019 ft^2) for mock-up
Orbiter/Spacelab Mock-up	Part of 36/1014 and new walled area in 36/1010	207	(2224)	345	(3,700)	Area is 22.3 m (73.4 ft) by 9.2 m (30.3 ft)

Table 4-2 (continued)

COMPARISON OF ACCOMMODATIONS VS. REQUIREMENTS - SHARET LSP INTEGRATION FACILITY

Subfacility	PROPOSED DESIGNS: Location Building/Room	PROPOSED DESIGNS: Space m^2	PROPOSED DESIGNS: Space (ft^2)	REQUIREMENTS: Space m^2	REQUIREMENTS: Space (ft^2)	Remarks
Data Lab	36/2025	68	(728)	55	(600)	
Test Control/Flight Support Area	36/2018, 36/2025A, 36/2030	268	(2,878)	195	(2,100)	
Facility Maintenance Area	Assume all necessary support from Buildings 325, 327 and 329	145 (assumed)	(1,550)	145	(1,550)	
General Purpose Scientific Lab	37/lab areas, 36/1002A	2,185	(23,495)	2,000	(21,500)	
Office and Meeting Room Space	36/112, 36/20256, 37/1-36, other TBD areas	listed areas 133 TBD areas 677	(1,436) (7,264)	810	(8,700)	
TOTAL		** 5,242	(56,348)	5,080	(54,650)	** includes 1596 m^2 (17,162 ft^2) located in remote areas which are TBD

LSP Dedicated Facility Description

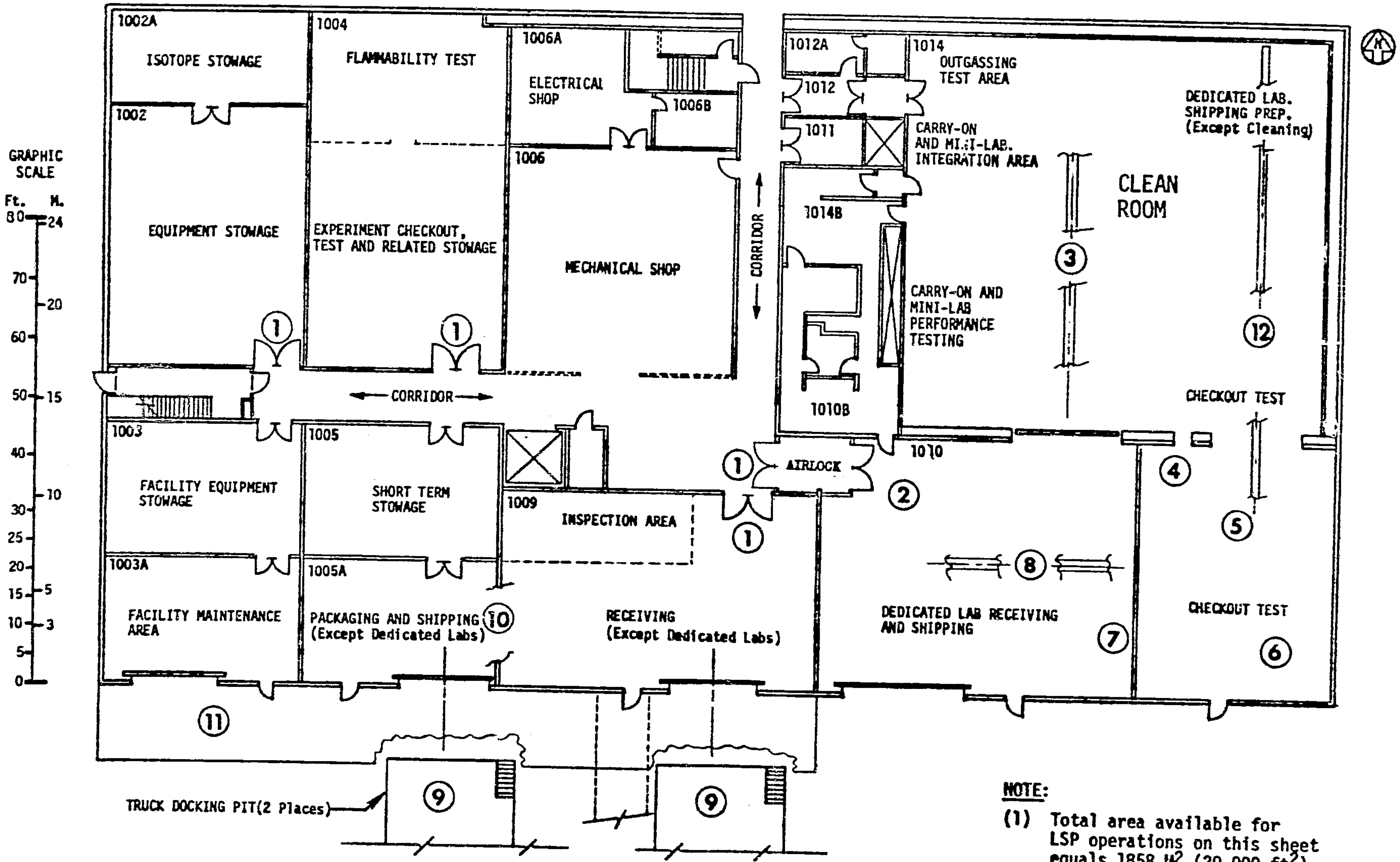
The dedicated Integration Facility concept described in the following paragraphs provides a "full-up" capability within Building 36 for supporting all currently defined JSC LSP operations. The three levels of the Building 36 south wing contain approximately 3,160 m^2 (34,000 ft^2) of usable floor area and can meet primary JSC Life Science payload integration and testing requirements based on the Dunning traffic model (Reference 7). As in the shared facility concept, the one story 960 m^2 (10,300 ft^2) north wing of the building would be used chiefly to provide office space for NASA personnel.

A central location contains all subfacilities required for LSP processing within the dedicated Integration Facility concept, with the exception of the general purpose laboratories currently existing in Building 37, and a portion of the LSP associated storage areas.

Assignment of all other LSP subfacilities into an area of the south wing of Building 36 is shown in Figures 4-4 through 4-6. Circled numbers on Figure 4-4 correspond to the similarly numbered descriptions of required modifications to the existing facility listed in Table 4-1.

Payload processing tasks within Building 36 for the dedicated facility concept include operations as previously described, plus additional activities which would be relegated to remote areas with the shared Integration Facility concept. (Examples of additional areas located within the facility for the dedicated facility concept include PI office space located on the third floor, portions of the experiment development and component test areas, and a large percentage of the total required Integration Facility storage space.)

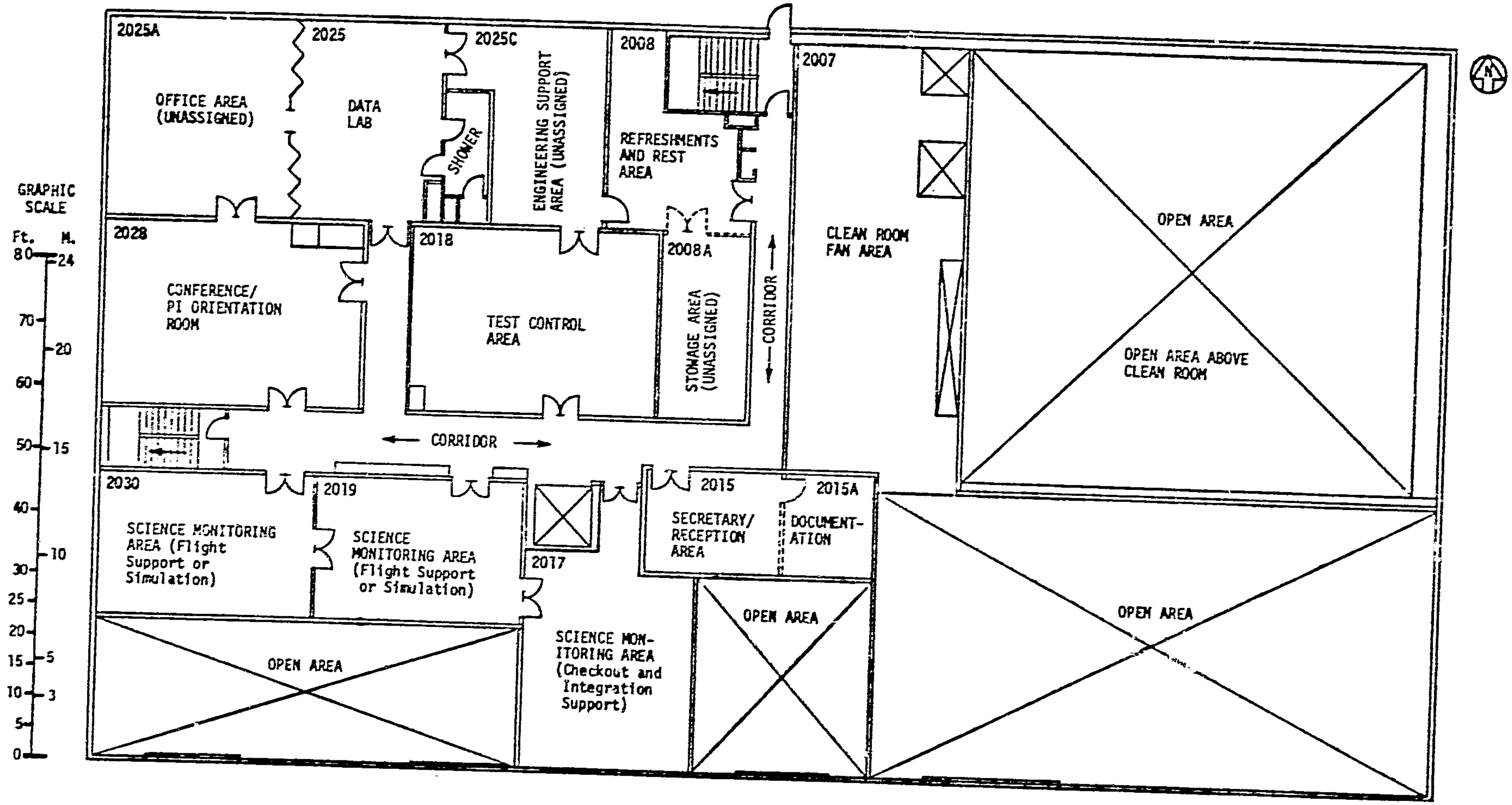
A candidate layout of the clean room areas for this approach is shown in Figure 4-7. Modifications to expand the clean room area into Room 1010 would be performed similarly to those required by the shared facility concept.



NOTE:

(1) Total area available for LSP operations on this sheet equals 1858 M^2 (20,000 ft^2)

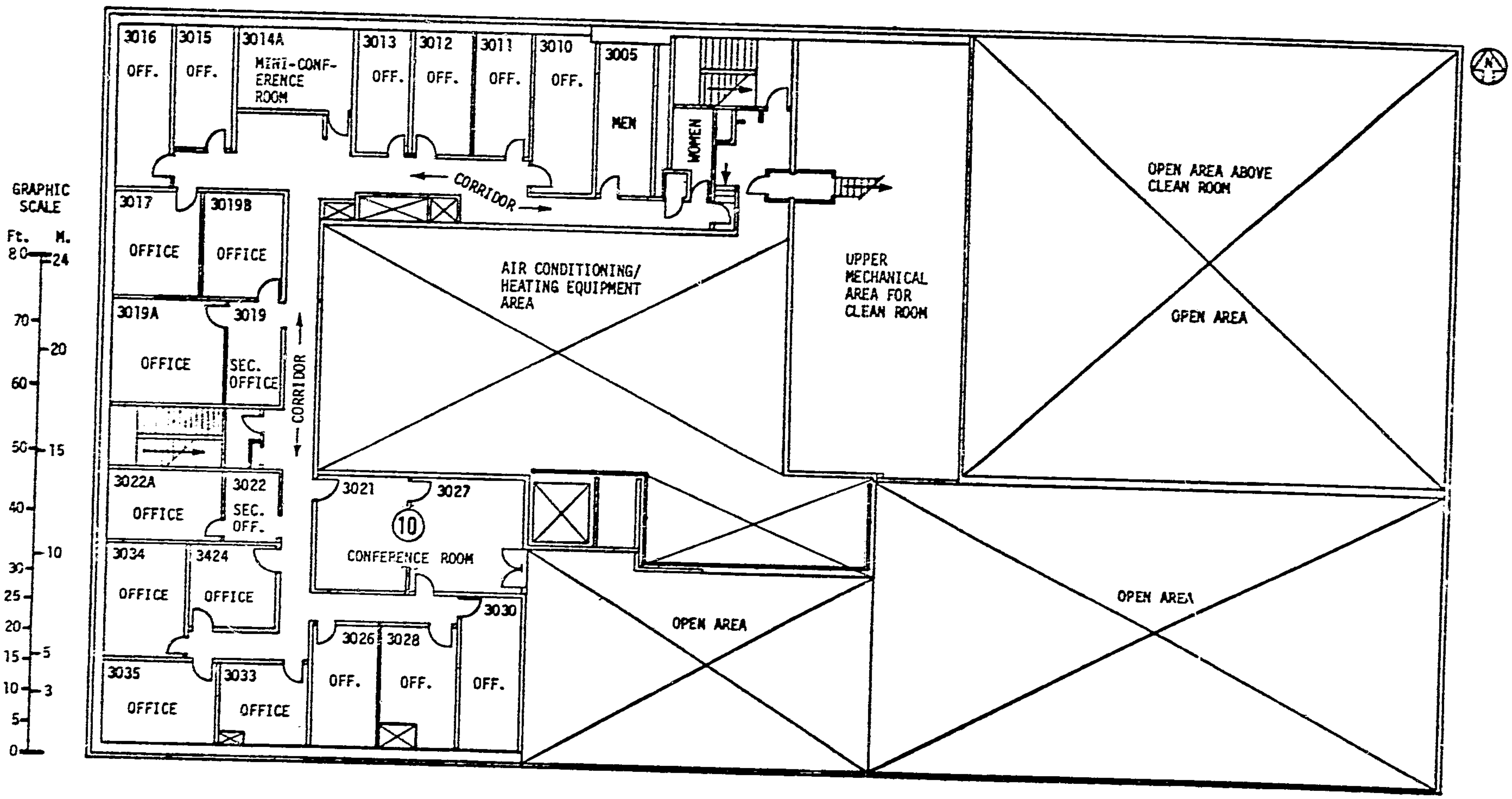
FIGURE 4-4: Life Sciences Facility Layout, Dedicated Processing Facility, Building 36, South Wing, First Level



NOTE:

(1) Total area available for LSP operations on this sheet equals 808 M^2 (8,700 ft^2)

FIGURE 4-5: Life Sciences Facility Layout, Dedicated Processing Facility, Building 36, South Wing, Second Level



NOTE:

(1) Total area available for LSP operations on this sheet equals 492 M^2 (5,300 ft^2)

FIGURE 4-6: Life Sciences Facility Layout, Dedicated Processing Facility, Building 36, South Wing, Third Level

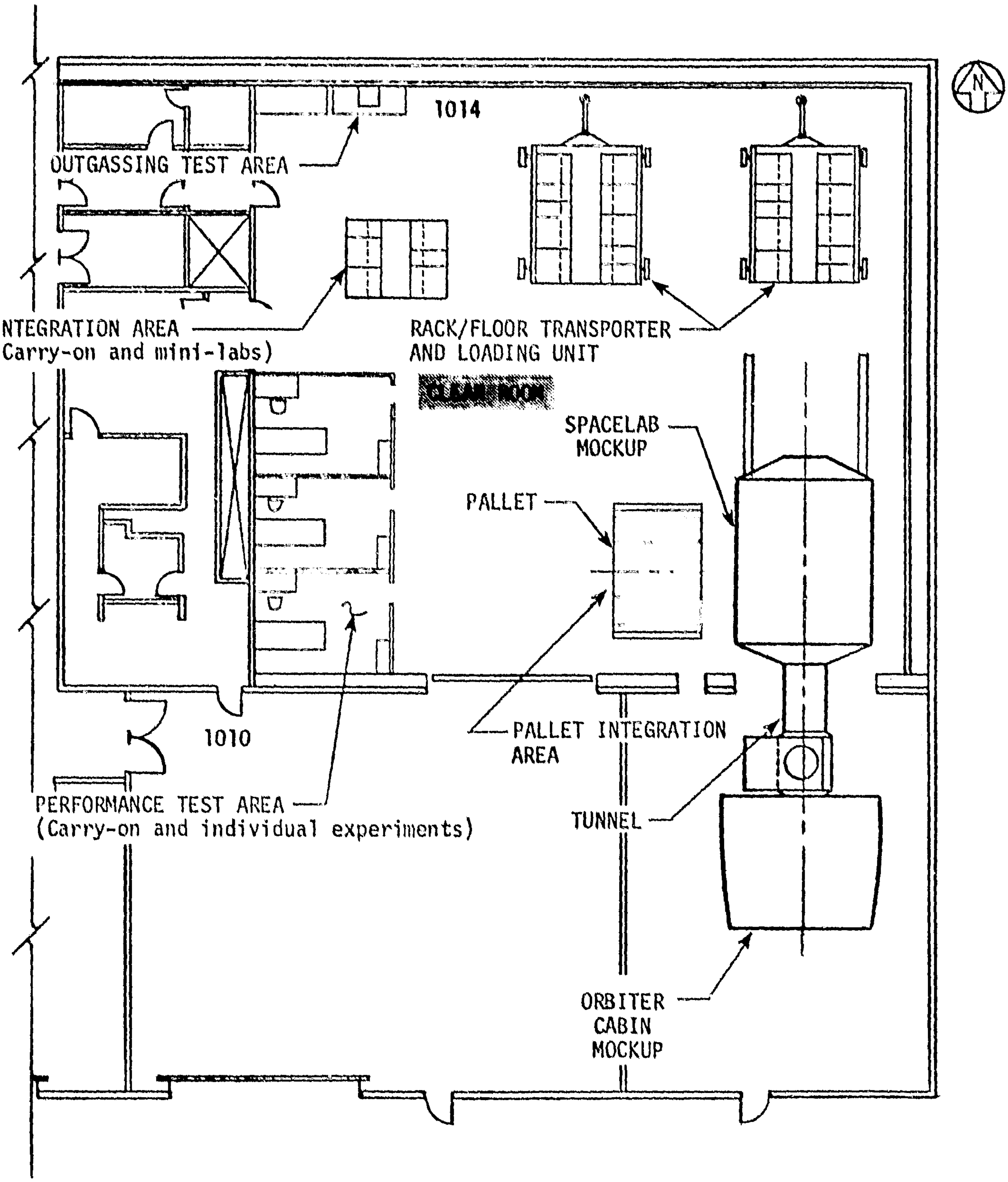


FIGURE 4-7: Conceptual Layout of Life Sciences Payload Checkout Test Area, Dedicated Processing Facility

A comparison of the floor space accommodations provided by the dedicated Integration Facility design versus the postulated requirements developed as outlined in Section 2 is shown in Table 4-3. The dedicated Integration Facility design utilizes approximately eight percent more total floor area than indicated from a summation of the individual theoretical subfacility requirements. Inspection of Table 4-3 shows that all subfacility area allocations are reasonably well matched to the theoretical area requirements to which they correspond.

Implementation Schedule

Network flow charts for LSP processing operations were analyzed and charts indicating the time-phased processing requirements of key subfacilities in the Integration Facility were prepared. An example of this procedure showing the processing load build-up and steady state level of effort required for the Receiving and Shipping Subfacility is indicated in Figure 4-8. Examination of similar charts prepared for other major subfacilities determined that the Integration Facility should be capable of performing initial payload processing operations as early as late 1978. From this point a near linear increase in payload processing capability is required until full facility capability is reached by mid-1981. The recommended Integration Facility implementation schedule with significant milestones is indicated in Figure 4-9.

Costing

Cost estimates for the major Building 36 facility modifications are shown in Table 4-4. No significant modification cost differential was identified for either the shared or dedicated Integration Facility concept. Cost estimates are limited to Building 36 modifications, as modifications to other buildings are expected to be minor in comparison.

TABLE 4-3

COMPARISON OF ACCOMMODATIONS VS. REQUIREMENTS - DEDICATED LSP INTEGRATION FACILITY

Subfacility	PROPOSED DESIGNS			REQUIREMENTS		Remarks
	Location Building/Room	Space m^2	(ft^2)	Space m^2	(ft^2)	
Shipping and Receiving	36/1009, 36/1005A, part of 36/1010 and 36/1014, dock area	517*	(5,556)	300	(3,250)	119 m^2 (1280 ft^2) of 36/1010 used. 36/1014 space used on "as required" basis. *Includes outside dock.
Special Requirements/Items Holding Area	TBD (experiment dependent)	90 (assumed)	(950)	90	(950)	
Equipment Storage	36/1002, 36/1005, 36/1014, outside	653	(7,022)	665	(7,150)	93 m^2 (1,000 ft^2) of 36/1010 used for integrated payload storage
Experiment Test/Checkout Lab	36/1004, 36/1014	161	(1,730)	80	(850)	Includes 28 m^2 (300 ft^2) in clean room
Experiment Development Lab	36/1006, 36/1006A, 36/1006B	192	(2,070)	165	(1,800)	
Clean Room Integration Area	36/1014	235	(2,534)	230	(2,500)	
Orbiter/Spacelab Mockup	36/1014	278	(2,992)	345	(3,700)	
Data Lab	36/2025	68	(728)	55	(600)	Existing raised floor
Test Control/Flight Support Area	36/2018, 36/2017, 36/2019, 36/2030	309	(3,320)	195	(2,100)	

TABLE 4-3

COMPARISON OF ACCOMMODATIONS VS. REQUIREMENTS - DEDICATED LSP INTEGRATION FACILITY (continued)

Subfacility	PROPOSED DESIGNS: Location Building/Room	PROPOSED DESIGNS: Space m^2	PROPOSED DESIGNS: Space (ft^2)	REQUIREMENTS: Space m^2	REQUIREMENTS: Space (ft^2)	Remarks
Facility Maintenance Area	36/1003, 36/1003A	148	(1,594)	145	(1,550)	
General Purpose Scientific Lab	37/lab areas, 36/1002A	2,185	(23,493)	2,000	(21,500)	
Office and Meeting Room Space	36/third floor, 36/112, 37/1-36, 36/2028	656	(7,060)	810	(8,700)	
	TOTAL	5492	(59,049)	5,080	(54,650)	

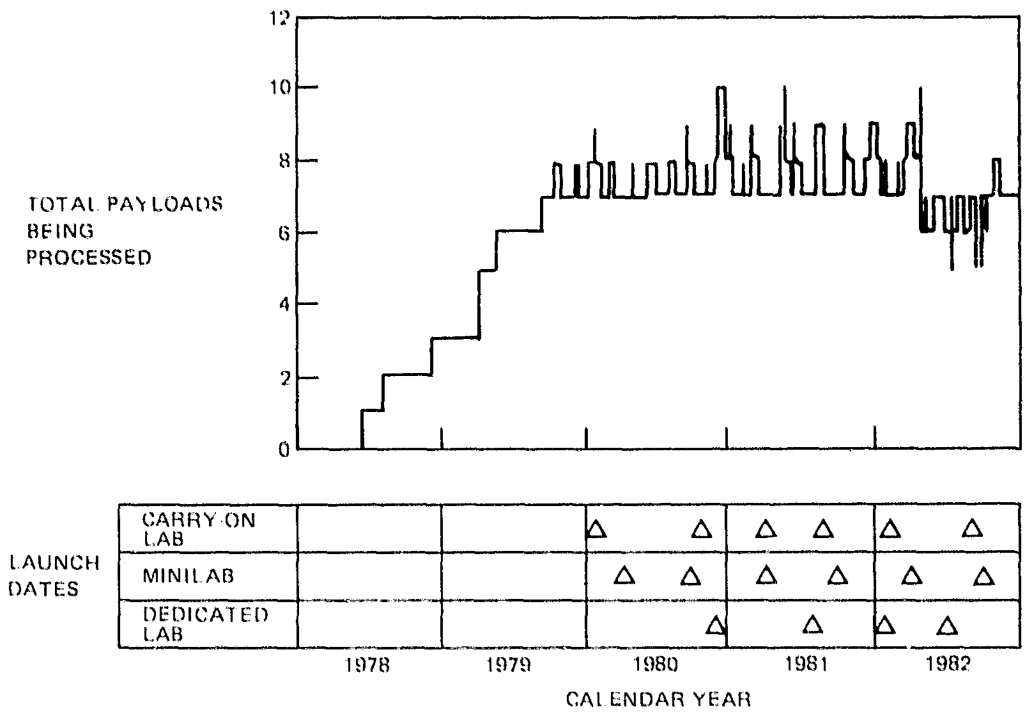
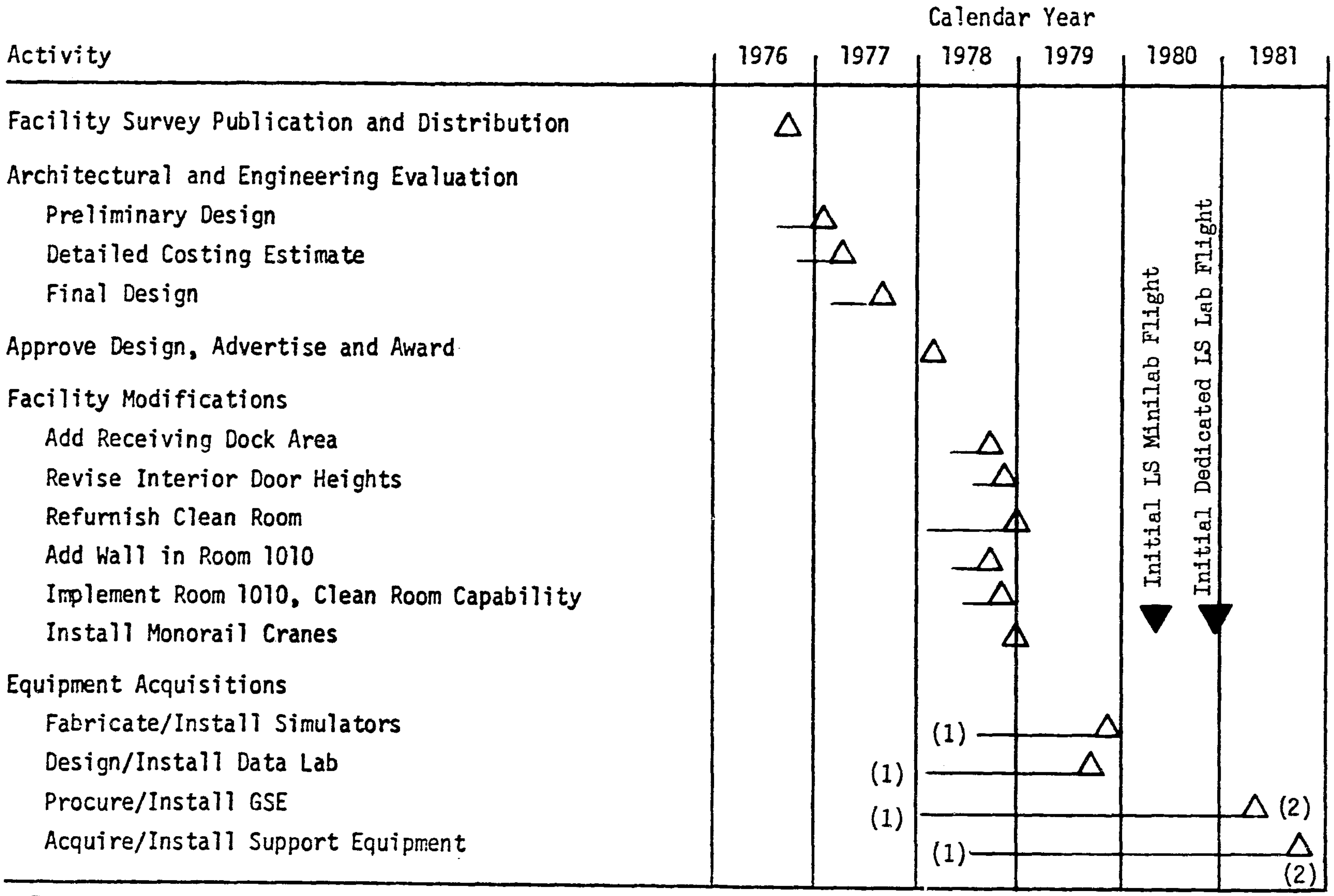


Figure 4-8. Receiving and Shipping Subfacility Processing Requirements for Integrated LSP Facility

FIGURE 4-9: INTEGRATION FACILITY IMPLEMENTATION SCHEDULE



NOTE:

(1) Existing capability, upgraded as required, to be used prior to implementation of operational era capability.
(2) Items acquired and installed as needed to support actual payload requirements.

Table 4-4

INTEGRATION FACILITY ROUGH ORDER OF MAGNITUDE COST DATA (1)

MODIFICATIONS TO BUILDING 36

• Enlarge Interior Doors	$ 2.3K
• Add Airlock to Room 1010	4.5K
• Install 9 x 10^3 Kg (10 Ton) Crane	10.5K
• Remove Door and Track	4.0K
• Refurbish Room 1010	13.0K
• Remove walls	2.4K
• Install wall and modify room 1010	14.0K
• Install 18 x 10^3 Kg (20 Ton) Crane	12.0K
• Build Truck Cargo Pits	31.0K
• Install Canopy over Pits	12.5K
• Install 1.8 x 10^3 Kg (2 Ton) Crane	7.5K
• Refurbish Clean Room	21.0K
	$134.7K

EQUIPMENT COSTS (2)

• NASA/ESA GSE	$ 0.77 million
• Other GSE	0.94 million
• Other Support Equipment	.33 million
	$ 2.04 million
TOTAL	**$ 2.17 million**

NOTE

(1) See Reference 6 for conditions and assumptions used in determining ROM cost estimates.

(2) Development costs, where applicable, not included.

Also included in Table 4-4 are equipment costs developed as described in Section 2. All costs shown in the table are non-firm, rough order-of-magnitude, preliminary engineering estimates. The following conditions and assumptions were used to arrive at the cost figures:

a) Orbiter/Spacelab mockups and subsystems, and automated test equipment costs are not included as these items will require additional preliminary design engineering analyses of functions to be provided prior to costing. Data lab computer equipment is assumed to be leased.

b) Cargo lift trailers (transport aircraft GSE), vans, forklifts, and movable cranes are available at no cost from existing government equipment.

c) No costs are assessed for the use of scientific lab equipment.

d) Certain experiment dependent specimen related costs are not included. Examples are waste/dead animal disposal facilities, data monitoring equipment, and holding units.

e) Design development, set-up, and interface connection and verification costs are not included.

Excluding the items mentioned above, and based on the listed assumptions, a total ROM cost of approximately $2.17 million will be required to implement Integration Facility operations. About $100,000 of this amount is accounted for by office furniture, storage cabinets, workbenches, and similar equipment which may be available from within NASA.

Section 5

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Current JSC facility accommodations are suitable for use as a Life Science Payloads Integration Facility with relatively minor modifications. Building 36, the Bioengineering and Test Support Facility, is well suited for use as either a shared payload processing facility or as a facility dedicated to operations involving only Life Science payloads. Operations involving receiving and shipping, integration, test and checkout, test monitoring and in-flight science support may be accomplished within the building for either mode of operation. Life Science laboratories, which are currently being centrally located into Building 37, should be capable of supporting the laboratory requirements of the Integration Facility, and crewmember and test subject medical examination support can be provided by existing accommodations in Building 8.

The dedicated Integration Facility concept was found to be capable of providing slightly more cost effective payload processing and of providing more flexibility in scheduling of operations when Life Science needs were considered independently from the requirements of other JSC disciplines. However, an overview of JSC center-wide payload processing requirements with an evaluation of the various possible tradeoff decisions should be conducted to indicate the most cost effective overall Integration Facility approach. Final selection of the shared or dedicated mode of operations should be made based on visibility of the total long range payload processing requirements to be conducted by all disciplines at JSC, and on projected resource availability at the center during the entire STS era. An effort of this magnitude was outside the scope of the contractual tasks described in this report.

The preliminary, rough order-of-magnitude cost estimates for facility modifications to convert Building 36 for LSP operations are $135,000. Costs of

GSE needed to process experiment and Spacelab flight hardware are projected to be slightly in excess of $1.7 million. Other Integration Facility support equipment costs are estimated at $0.3 million. Costs for design, development, verification, utility support and equipment interface connections are not included in these figures. Costs for mock-up structures and subsystems, computerized test monitoring equipment, and specialized items of specimen holding equipment are also not included due to current lack of design details (see Reference 6). These costs are not expected to be significantly changed by the selection of either the shared or the dedicated Integration Facility mode of operation.

The Integration Facility should be capable of performing initial receiving and experiment processing activities as early as 1978. A phased build up to full operational capability should be completed by 1981. Until that time, with either payload processing concept, a portion of the sapce within the Integration Facility will be available for operations other than those directly involved with Life Science payload processing.

Recommendations

The following recommendations are made as a result of the facility survey:

(a) The JSC Life Sciences Directorate should take necessary steps to ensure that the required facility areas as indicated in this survey are made available for LSP processing in the Space Shuttle era.

(b) The selected Integration Facility design should be submitted to JSC Facilities Engineering personnel or to an Architectural and Engineering (A&E) consultant for more detailed facility modification design, costing and schedule information.

(c) Additional survey effort should be expended to determine the parametric impacts on Integration Facility requirements resulting from an altered Life Science traffic model.

(d) The top level subfacility requirements identified by this survey should be expanded to include an additional level of detail for all subfacilities. Particular emphasis is needed to define the Spacelab and Orbiter structural configurations and subsystems necessary to imitate the functions of flight hardware during test, training, interface verification and checkout.

(e) A make/buy cost effectiveness analysis should be performed for each item of NASA/ESA GSE applicable to Integration Facility activities. The specific capabilities of NASA/ESA GSE items should be compared to more detailed Integration Facility requirements than was possible within the scope of this survey. Particular emphasis should be placed on the characteristics of in-building transporters, dollies, and flight hardware handling equipment. For GSE components where a "make" decision is reached, preliminary design of long lead time and high complexity items should be initiated. Preliminary procurement actions should be initiated for "buy" category GSE.

Section 6

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